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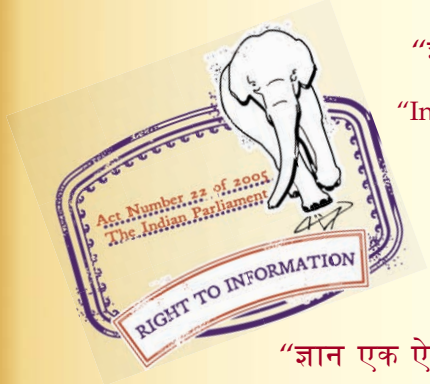
IS 6410 (1991): magentic flaw detection inks and powders
[MTD 21: Non-Destructive Testing]



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"Knowledge is such a treasure which cannot be stolen"

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IS 6410 : 1991
(Reaffirmed 2000)

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(पहला पुनरीक्षण)

Indian Standard

MAGNETIC FLAW DETECTION INKS AND POWDERS — SPECIFICATION

(First Revision)

UDC 667·4/1·5 [621·318·1] : 620·179·14

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 1991

Price Group 3

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Non-Destructive Testing Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1971. This was taken up for review by the committee and is now being issued as a revised standard with several modifications relating to material, tests, etc.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

MAGNETIC FLAW DETECTION INKS AND POWDERS — SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies the requirements for non-fluorescent and fluorescent inks, concentrates and powders used in magnetic flaw detection techniques.

2 REFERENCES

The Indian Standards listed below are necessary adjuncts to this standard:

IS No.	*Title*
IS 460 (Part 1) :1985	Wire cloth test sieves *(third revision)*
IS 3415 : 1980	Glossary of terms used in magnetic particle flaw detection *(first revision)*

3 TERMINOLOGY

3.1 For the purpose of this standard, definitions given in IS 3415 : 1980 shall apply.

4 DESCRIPTION

4.1 Magnetic Inks

4.1.1 Non-fluorescent and fluorescent inks, whether supplied ready for use or made up from concentrates, shall consist essentially of finely divided ferro-magnetic particles and a suitable carrier liquid. They shall form a uniform suspension when agitated. Certain other ingredients, in the proportions specified in **5**, may be present at the option of the manufacturer.

4.1.2 Inks shall not contain any ingredients that are generally recognized or known to cause injury or discomfort to operators during or after use.

4.1.3 Inks shall not corrode or otherwise adversely affect the surfaces of steel parts.

4.2 Powders

4.2.1 Powders shall consist essentially of finely divided ferromagnetic particles. Certain other ingredients, in the proportions specified in **5**, may be present at the option of the manufacturer.

4.2.2 Powders shall not contain any ingredients that are generally recognized or known to cause injury or discomfort to operators during or after use.

4.2.3 Powders shall not corrode or otherwise adversely affect the surfaces of steel parts.

4.3 The magnetic inks and powders shall meet the requirements of the appropriate tests specified in **7**.

5 COMPOSITION

5.1 Magnetic Inks

The composition of non-fluorescent and fluorescent inks shall be as follows:

a) *Ferromagnetic Particles (Including Adherent Non-magnetic Pigments)*

1. Non-fluorescent inks — In ready to use condition shall have a particle concentration of 1·5 to 2·0% volume/volume, as determined by the procedure given in Annex A.

2. Fluorescent inks — In ready to use condition shall have a particle concentration of 0·2 to 0·4% volume/volume, as determined by the procedure given in Annex A.

b) *Carrier Fluid* — The remainder.

5.2 Concentrates

Inks prepared from concentrates diluted with the appropriate carrier fluid in accordance with the manufacturer's instructions shall in all respects comply with the requirements stated in **5.1**.

5.3 Powders

The composition of dry magnetic powders shall be as follows:

a) *Ferromagnetic Particle (Including Ahderent Non-Magnetic Pigments)* — Not less than 95 percent by weight.

b) *Other Constituents* — The remainder.

6 MATERIALS

6.1 Ferromagnetic Particles and Other Solid Ingredients

6.1.1 *Powders*

The size of ferromagnetic particles and any of the solid ingredients for powders for wet

method shall be such that not less than 99 percent of a representative sample passes through a 63-μm mesh normal test sieve complying with IS 460 (Part 1) : 1985. The dry particles may consist of a mixture of particle sizes of 100 to 150 microns.

6.1.2 *Colour*

Fluorescent particles glow bright yellow-green when viewed under black light. Non-fluorescent particles are usually black or reddish brown, although other colours are available. The colour often chosen for any given examination should be one that contrasts most with the test surface of pipe or tube.

6.2 Carrier Fluid

The carrier fluid used in preparing the bath shall be a light, well-refined petroleum distillate of low sulphur, chlorine (halogen) and hydrogen content, preferably treated to reduce any unpleasant odours. The recommended characteristics of carrier fluid are:

Kinematic viscosity at 311°K (38°C)	3 to 5×10^{-6} (m^2 sec), *Max*
Flash point (Teg closed cup)	330°K (57°C), *Min*
Initial boiling point	473°K (200°C), *Min*
End point	533°K (200°C), *Max*
Colour (Saybolt)	+25

NOTE — The carrier fluid shall also be free from fluorescence quenching contaminants when used with fluorescent particles.

6.2.1 Use of any other carrier fluid shall be with mutual agreement of the purchaser and the supplier.

7 TESTS

7.1 Magnetic Inks

7.1.1 When tested in accordance with the method described in Annex A the total solid content (by volume) shall be:

a) *Non-fluorescent inks* — the total solid contents shall be 1·5 to 2·0 percent.

b) *Fluorescent inks* — the total solid contents shall be 0·2 to 0·4 percent.

7.1.2 When the ink is tested in accordance with the method described in Annex B, those parts of the artificial defect which are substantially at right angles to the flux shall be clearly visible in continuous outline.

7.1.3 When viewing fluorescent inks/particles, a black light spectrum (3 650°A, peak) compatible with the ink under test shall be used and its intensity minimum 970 lux (800 microwatt/ cm^2) shall be sufficient to provide enough fluorescent glow to facilitate comfortable viewing after reduced ambient light and dark adaptation.

7.1.4 When the ink is tested in accordance with the method described in Annex C, the amount of ferromagnetic particles shall be not less than 90 percent by weight of the total solids present.

7.1.5 When the ink is tested in accordance with the method described in Annex D, the steel bar shall not exhibit any evidence of corrosion or chemical attack.

7.2 Powders

7.2.1 The efficiency of magnetic powders shall be demonstrated by using the apparatus described in Annex B, and the requirements of **7.1.2** shall apply.

7.2.2 The requirements shall be the same as given in **7.1.3.**

7.2.3 When the powder is tested in accordance with the method described in Annex C, the percentage of ferromagnetic particles shall be not less than 95 percent by weight of the total.

7.2.4 When the powder is tested in accordance with the method described in Annex D, the steel bar shall not exhibit any evidence of corrosion or chemical attack.

7.3 Residual Field in Particles

The test for determining residual fields in the ferromagnetic particle in inks, powders, etc, shall be carried out as in Annex E.

7.4 Contamination and Functional Test

The bath prepared from powders, concentrates shall be checked by standard test piece No. 8 every day in the beginning. The contamination of foreign particles like dust cannot be measured in volumetric test, which may mislead Operator/ Inspector by showing correct concentration. This should be tested by test piece No. 3 as per instructions shown in Annex F.

8 MARKING

8.1 All the containers in the batch represented by the sample shall be marked with the date of manufacture and batch number together with the stamp of the inspection authority where appropriate. The containers may also be marked with caution symbols, wherever necessary.

ANNEX A

(*Clauses* 5.1. *and* 7.1.1)

DETERMINATION OF SOLID CONTENT OF INKS

A-1 PROCEDURE

A-1.1 Immediately after thoroughly mixing the ink (wet bath prepared from concentrates, etc), a 100 ml sample shall be transferred into a vertically supported 100 ml centrifuge tube. The sample is allowed to stand until the apparent line of demarcation between solids and liquid has attained a constant level. Read off to the nearest 0·1 ml the level reached by the solids and record it as the solids content by volume.

ANNEX B

(*Clauses* 7.1.2 *and* 7.2.1)

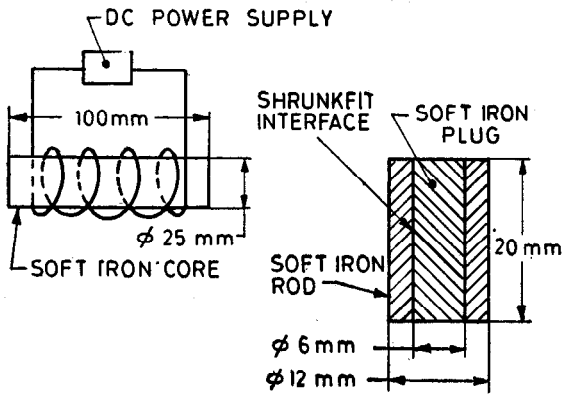
FUNCTIONAL TESTS

B-1 TEST

B-1.1 An electromagnet as shown in Fig. 1A is made of a soft iron core (low retentivity) so that it generates a magnetic field of 40 gauss.

B-1.2 The artificial defect specimen as shown in Fig. 1B consists of a 12 mm dia soft iron rod having a 6 mm dia hole which is 0·01 mm interference shrunkfit using a soft iron plug. After the shrink fitting, the ends shall be ground flush.

B-1.3 This defect specimen (Fig. 1B) shall be placed (*see* Fig. 2) in such a way that the 40 gauss (40 × 10^{-4} tesla) field from the electromagnet (Fig. 1A) passes radially through one of its ends. The particles in the form of suitably made inks, wet particle bath or in the dry powder form shall be applied to the above end of the specimen (Fig. 1B), and shall be capable of developing the leakage flux arising from the portion of the shrunk-fit boundary lying at right angles to the field of the electromagnet (Fig. 1A).



1A Electromagnet 1B Artificial Defect Specimen

FIG. 1 APPARATUS FOR FUNCTIONAL TEST

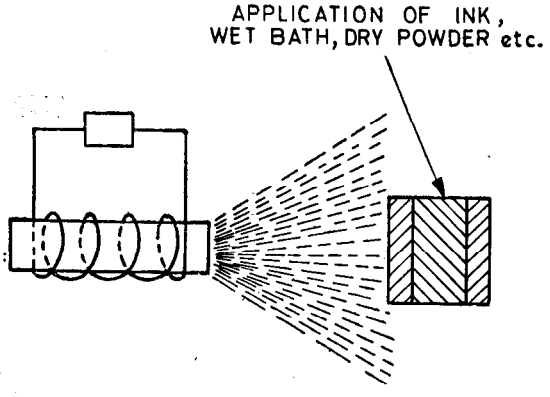


FIG. 2 SCHEMATIC VIEW OF THE POSITIONING OF THE MAGNET AND THE SPECIMEN FOR FUNCTIONAL TEST

ANNEX C

(*Clauses* 7.1.4 *and* 7.2.3)

DETERMINATION OF FERROMAGNETIC PARTICLE CONTENT

C-1 INKS

C-1.1 50 ml of a representative sample of the ink shall be taken in 100 ml glass beaker and this shall be exposed to the electromagnet so that one pole dips into the beaker. Whilst gently agitating the ink with a glass rod, the magnet shall be allowed to leach all the magnetic

particles from the ink. (It will be necessary to wipe the pole piece with filter paper and repeatedly dip it into the ink until no more magnetic particles adhere).

C-1.2 The dry weight W_1 of the non-magnetic particles shall be determined by filtration through a tared sintered glass crucible (G No. 4) and washing with a suitable volatile solvent.

C-1.3 The dry weight W_2 of the total solids in a 50 ml representative sample of ink shall be determined by filtering all the sample through a tared sintered glass crucible (G No. 4).

C-1.4 The amount of ferromagnetic particles W_3 is expressed as a percentage of the total W_2 as follows:

$$W_3 = \frac{W_2 - W_1}{W_2} \times 100$$

C-2 POWDERS

C-2.1 One gram of the powder weighed on to a previously weighed flat microscope slide.

C-2.2 The heap of powder on the slide shall be presented to within 1 mm of the lower face of one pole of electromagnet, that is, without touching the powder. Ferromagnetic particles on the slide away by 12 mm from the pole piece will be attracted to the pole piece. The cycle shall be repeated till all particles are collected.

C-2.3 Determine the weight of ferromagnetic particles attached to the pole and express as a percentage of the total weight of 1·0 g.

ANNEX D

(*Clauses* 7.1.5 *and* 7.2.4)

CORROSION TEST

D-1 PROCEDURE

D-1.1 A machined bar of low carbon steel approximately 150 mm long and not less than 12·5 mm in diameter having a smooth surface texture shall be immersed partially in a sample of the ink or powder for not less than 12 h.

D-2 EXAMINATION

D-2.1 At the end of the 12 h period the surface of the bar shall be examined visually.

ANNEX E

(*Clause* 7.3)

TEST FOR RESIDUAL FIELD IN PARTICLES

E-1 PROCEDURE

A 50-ml sample of the ink/wet bath or 1 g of the dry powder shall be subjected to a magnetising field of 1 kilo gauss for one minute. After removing this external magnetising field, the following procedure shall be carried out:

a) *For Inks and Wet Baths* — A thoroughly demagnetised piece of soft iron shall be dipped into the ink bath sample and the excess bath ink is shaken off. There shall be no particle accumulation on the soft iron piece.

b) *For Dry Powders* — A soft iron piece as mentioned in (a) above shall be brought very near to the powder sample and there shall be no particles accumulation on the soft iron piece.

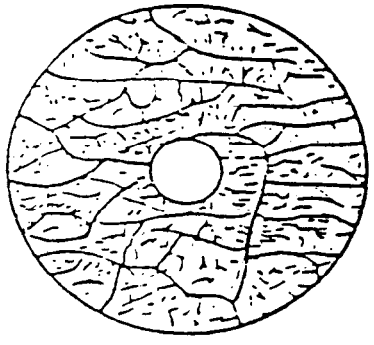
ANNEX F

(*Clause* 7.4)

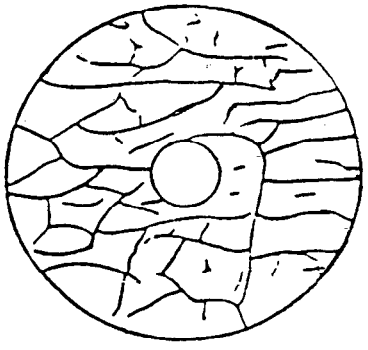
CONTAMINATION AND FUNCTIONAL TEST

F-1 The reading for the inspection medium concentration does not constitute a measure for the quality of the inspection medium (content of non-fluorescent and non-magnetization substances). For this purpose, a separate test is required using test speciman. For checking

purposes, a separate test specimen shall be used for each machine. From the multiple number of cracks, a certain zone is selected, which is examined during each check for possible changes (*see* Fig. 3).



Satisfactory inspection medium

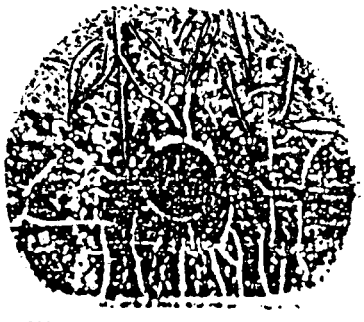


Unsatisfactory inspection medium

Right concentration

Low concentration

When powder is coarse



When medium/powder is dirty

FIG. 3

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, tosting and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use oft he Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

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